

Extracurricular Activities to Improve the Perception of Informatics in Secondary Schools

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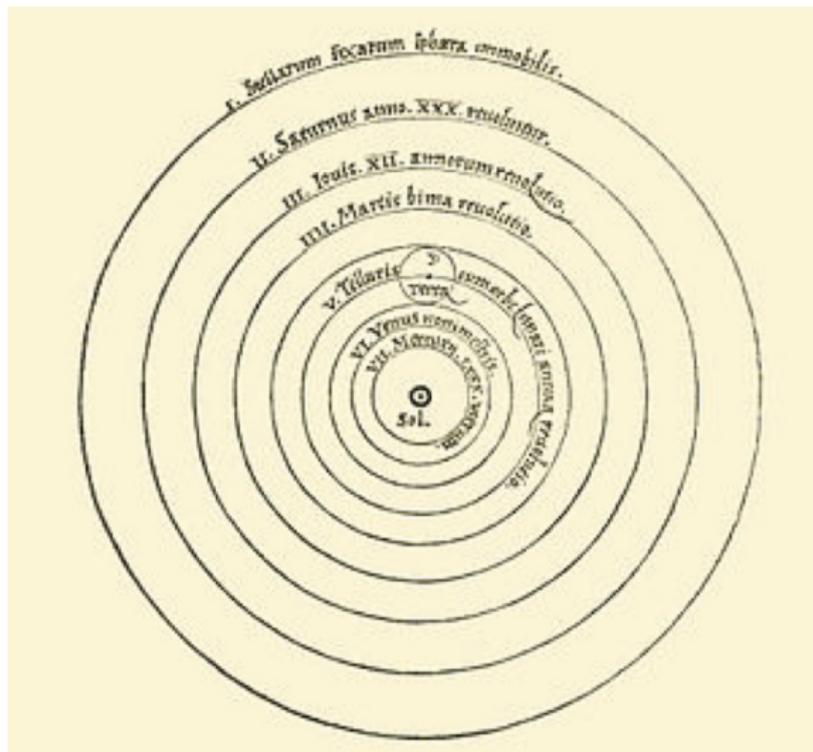


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Università degli studi di Milano
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Informatics / computer science: what is it?



Another informatics...

“We need to do away with the myth that computer science is about computers.

Computer science is no more about computers than astronomy is about telescopes, biology is about microscopes or chemistry is about beakers and test tubes.

Science is not about tools, it is about how we use them and what we find out when we do.”

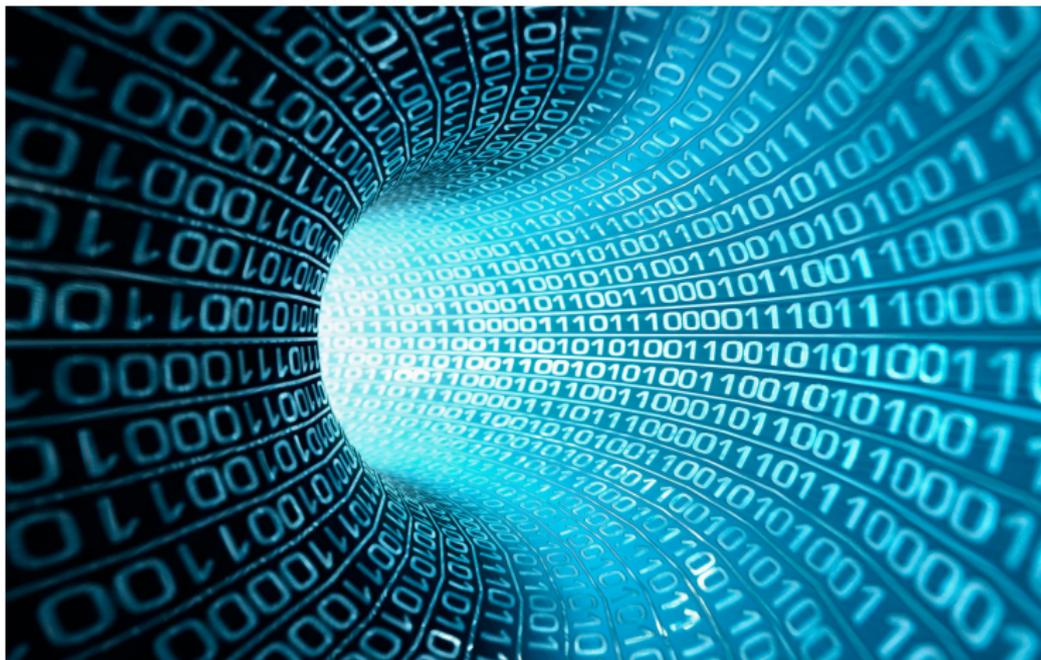
Micheal R. Fellows, Ian Parberry

Automatic

Automatic
Processing

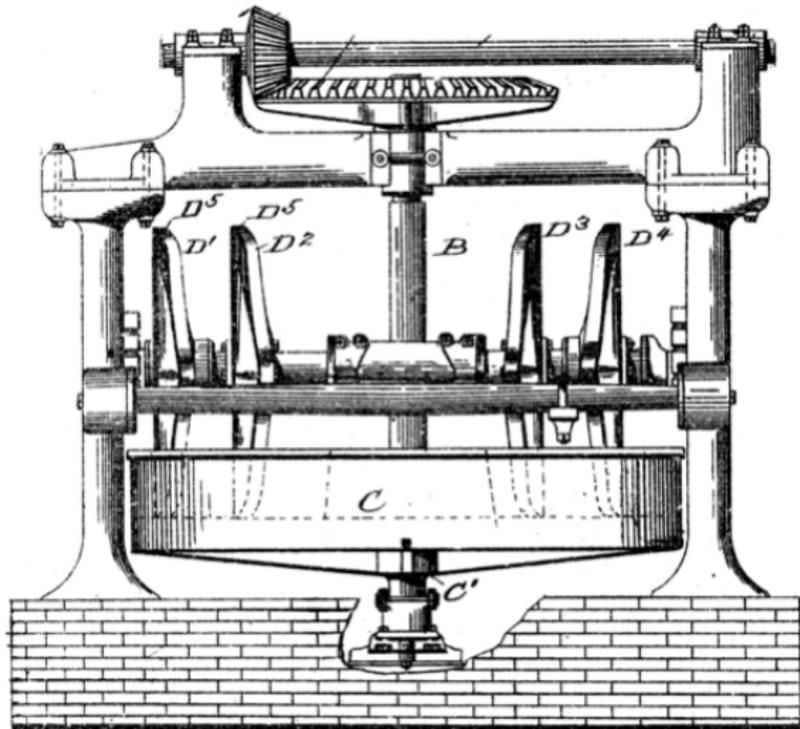
Automatic
Processing
of Information

What is information? How can *symbols/numbers* be used to represent it?

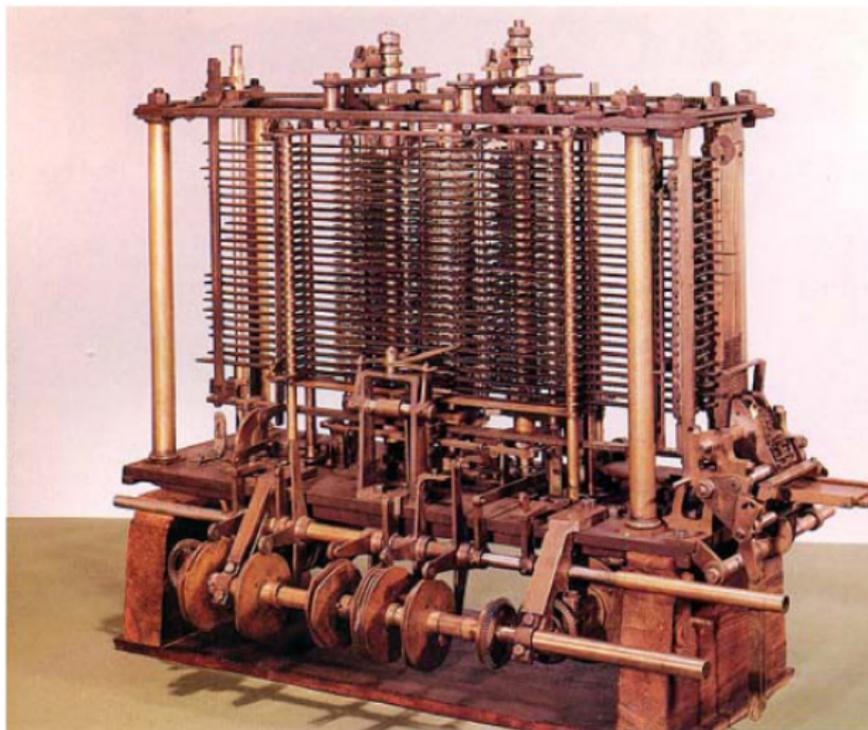


Processing

How can information be *manipulated/changed* in order to produce new knowledge?



Which manipulations can be performed by a *mechanical* interpreter? How this can be done?



Algomotricity - a methodological approach

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means to perform or implement an informatic process by
motorial/physical/manipulative/playful/concrete/tactile activities
using some form of dramatization.

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Use of computer

Computers and software tools should be of secondary importance, but the conceptual link with them should be clear.

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Background

Problem based learning, experiential learning theory, active learning, allosteric environment, kinesthetic learning activity, . . .

Background - Problem-based learning (PBL)

- PBL designs an educational environment promoting the investigation, explanation, and resolution of *meaningful* problems.
- In PBL, students work in small collaborative groups and learn what they need to know in order to solve a problem.

[Barrows, 1960s]

Background - Experiential learning theory

- It is the process whereby knowledge is created through the transformation of experience.
- Immediate or concrete experiences are the basis for observations and reflections,
- these reflections are assimilated and distilled into abstract concepts
- from which new implications for action can be drawn.

[Kolb, 1970s]

- The responsibility of learning is on learners
- They must read, write, discuss, or be engaged in solving problems.
- Active learning engages students in two aspects: doing things, and thinking about the things they are doing (metacognition).

[Bonwell and Eison, 1991]

Background - Allosteric environment

- The direct transmission of knowledge should be kept to a minimum,
- the teacher becomes a mediator who has to propose a heuristic environment that may interfere with the learner *sitting conceptions*;
- pupils should be free to explore a situation in order to reconsider their *mental models* by discovering concepts autonomously.

[Giordan 1996]

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The cognitive process:

- 1 the physical activity focuses on the informatic process considered
- 2 the process is repeated, generalized and analyzed by pencil and paper
- 3 the relationship with computer is clarified by an experimental activity through the use of specifically conceived software.

Some workshops we propose

<i>Grade</i>	<i>4th-7th</i>	<i>8th-11th</i>	<i>12th-13th</i>
information	Wikipasta	Human Pixels	Human Pixels (adv.)
automation	Mazes	Mazes (adv.)	
processing		Greedy Money (simpl.)	Greedy Money

- 60 classes (10-16 year old students) involved in 2-hours workshops
- On demand by accompanying teachers, we then organized 4 training seminars for teachers (around 70 participants)

Some workshops we propose

Human pixels: on the digital representation of images.

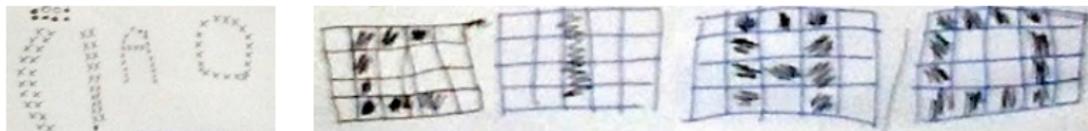


- video of animations made in stadiums by coordinated soccer teams supporters (“human LCD”)
- pupils are asked to discuss how to set up a very simplified version of such animations

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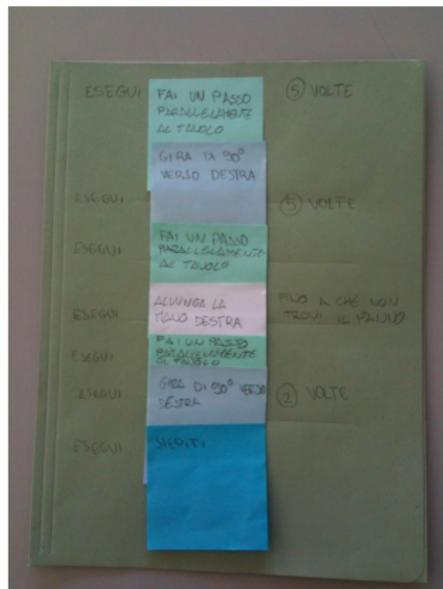
- they eventually discover grids, sampling, resolution, compression, . . .
- finally, pupils are provided with a multi-view editor showing a picture along with different representations.



Some workshops we propose

Mazes: on programming.

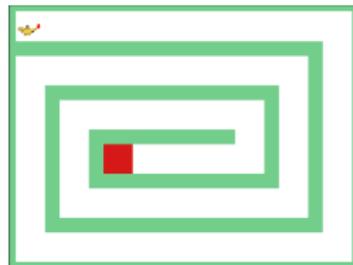
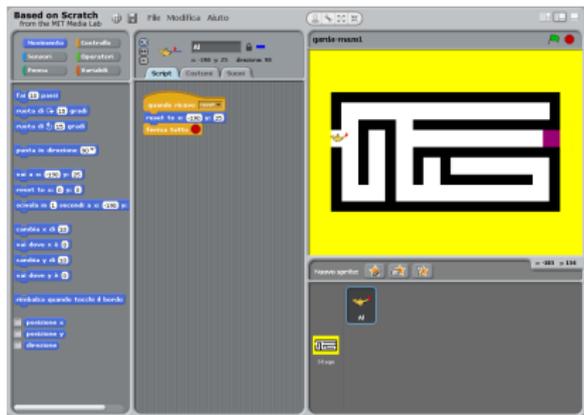
- pupils have to guide verbally a *human robot* (a blindfolded mate) through a simple path.
- they have to choose a very limited set of primitives and compose them into a program
- possibility of exploiting three basic control structures (if, repeat-until, repeat-*n*-times)



Some workshops we propose

Mazes: on programming.

- finally, pupils are provided with a visual programming language (a simplified version of MIT Scratch) and are asked to write programs guiding a sprite through mazes of increasing complexity.



Some workshops we propose

Greedy money: on greedy algorithms.

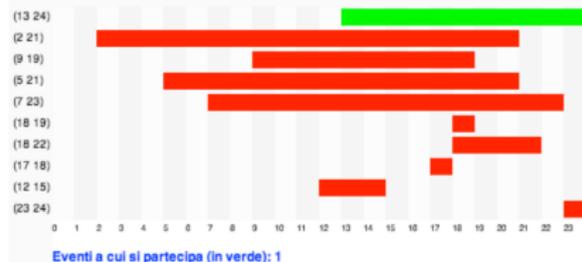
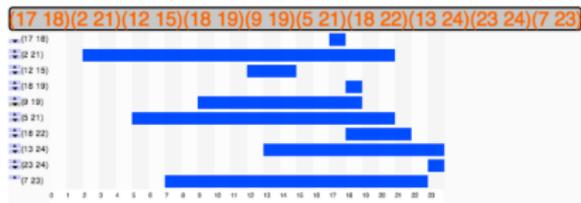


- change-making problem with a set of coins that admits a greedy solution.
- how to apply the same strategy to a scheduling problem ? (namely: maximizing the number of movies to be seen in a film festival whose program contains several, partially overlapping movies)

Some workshops we propose

Greedy money: on greedy algorithms.

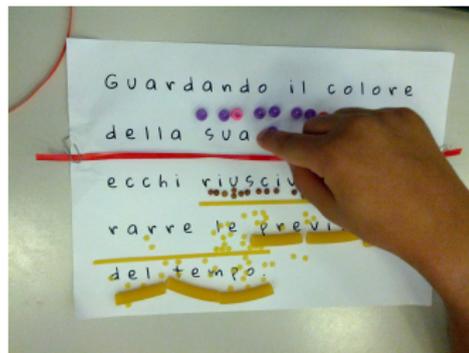
- find analogies between the two problems towards an abstract description of a greedy procedure.
- evaluate the suitability of the strategy in finding the optimal solution, with the support of software that generates at random a set of movies, rearranging them according to a chosen sorting criterion, and applying the greedy procedure.



Some workshops we propose

Wikipasta: on the role of text formatting and how to represent the meta-information it conveys.

- activity with pieces of pasta and other small objects
- discovery of mark-up languages
- introduction of a lightweight “wiki” syntax
- editing of Wikipedia-like pages



To convey a view of informatics as a scientific discipline, as opposed to the current mis-perception of the field, we propose:

- some core aspects of informatics to both pupils and teachers,
- a methodological approach to informatics teachers.